



Tool and Strategies for Engaging Students in Inquiry-based Earth System Science Field Studies

Martos Hoffman

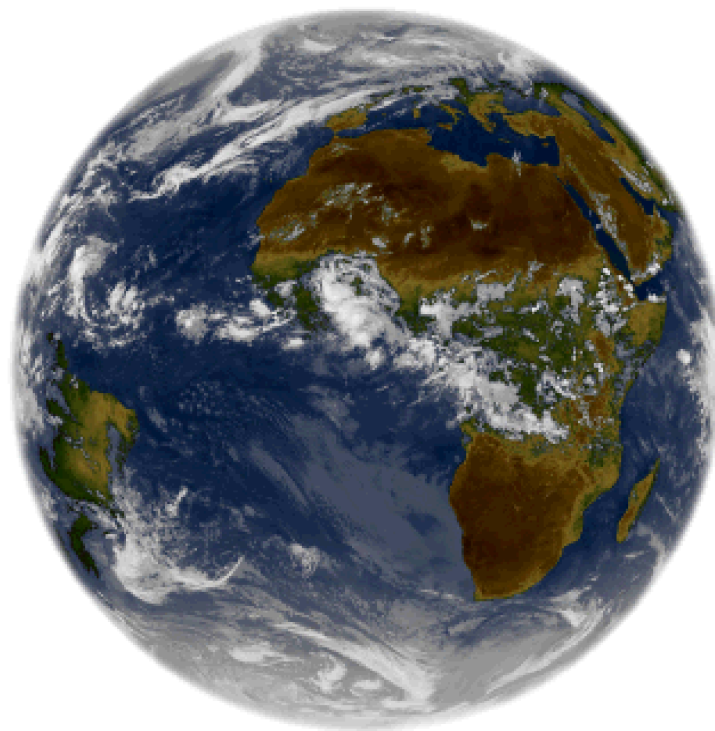
Head of Student Research

NSTA National Conference, San Francisco, California

11 March 2011



The **GLOBE** Program



***Engaging students in the
investigation of Earth***



THE GLOBE SCIENCE NETWORK

► Regions



111 GLOBE Countries

~ 40,000 GLOBE teachers

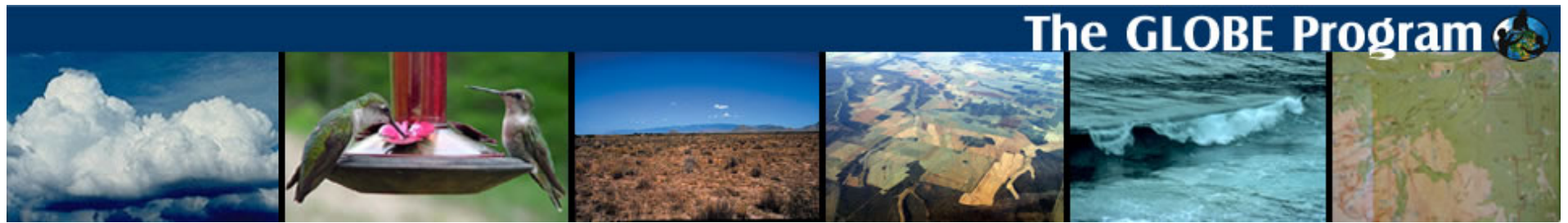
~ 20,000 schools worldwide



Essential Elements of GLOBE

GLOBE brings together an international community of STUDENTS, TEACHERS and SCIENTISTS to:

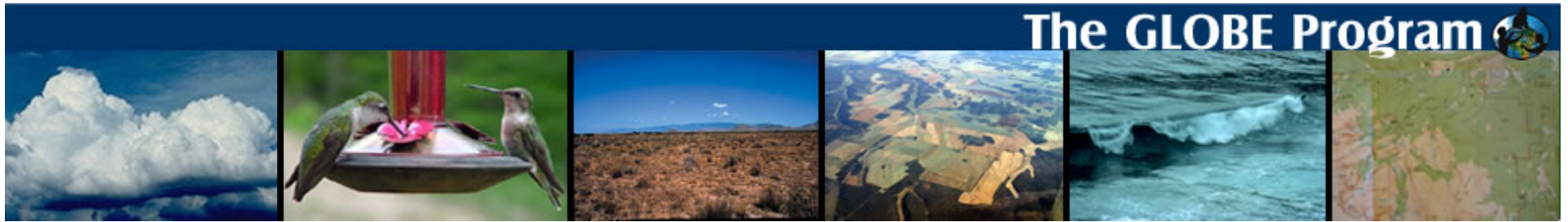
- Support improved student achievement in science and mathematics.
- Enhance environmental awareness of individuals throughout the world.
- Contribute to scientific understanding of the Earth.



GLOBE Educational Resources

- GLOBE Teacher's Guide
- Earth System Activities
- Student Data Activities
- GLOBE Cloud Chart
- Elementary GLOBE
- GLOBE Teacher Certification

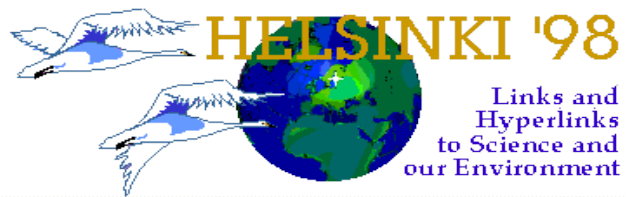




GLOBE Science Protocols

- Standardized methodology and equipment
- Student data contributes to global research
- Investigation areas
 - Atmosphere
 - Hydrology
 - Soils
 - Land Cover / Biology
 - Earth as a System

GLOBE Learning Expedition



Helsinki, Finland June 30 - July 4, 1998

GLOBE Learning Expeditions



Fayetteville, Arkansas, USA June 25 - 28, 2000

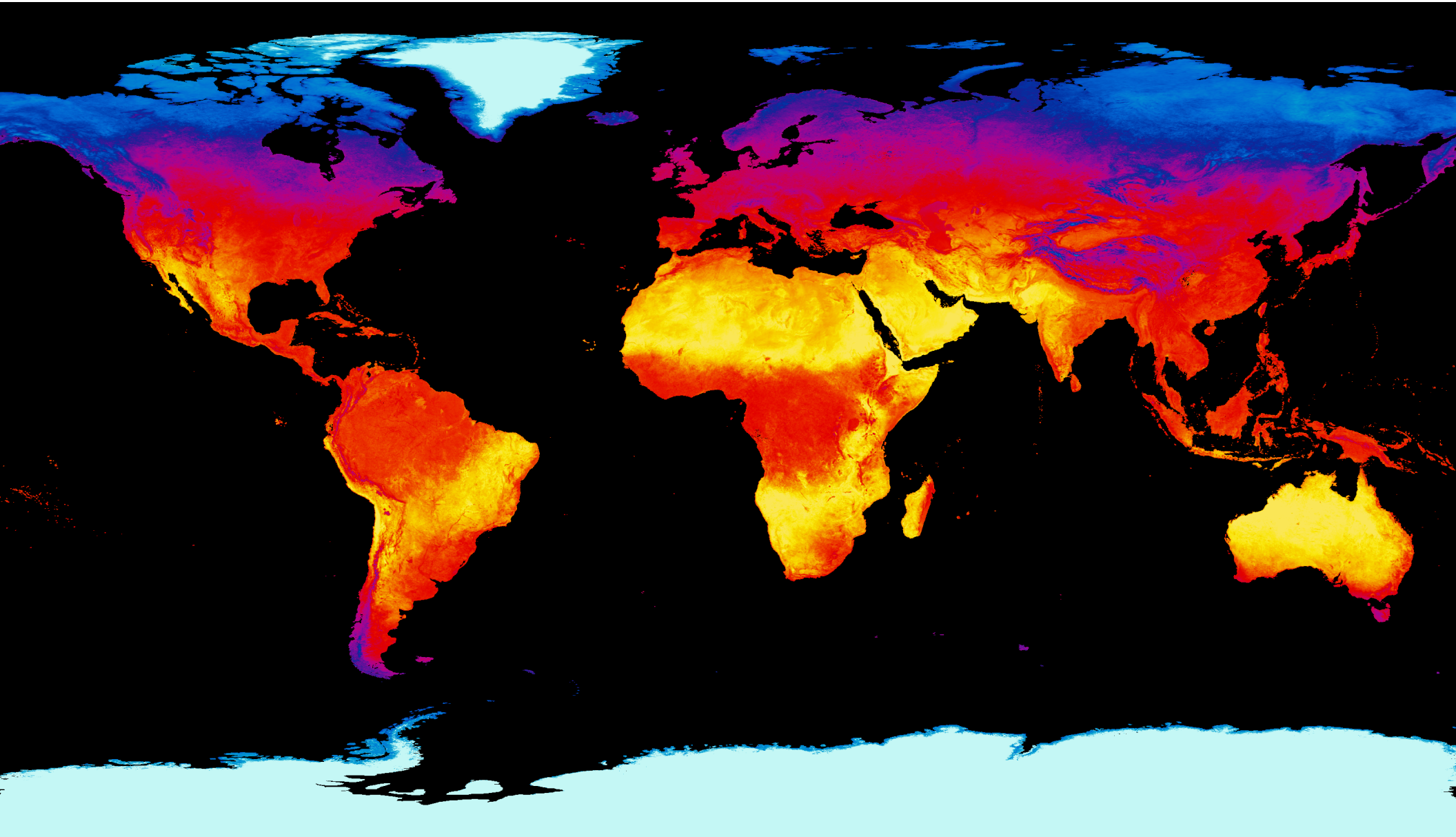


Šibenik, Croatia June 29 - July 4, 2003

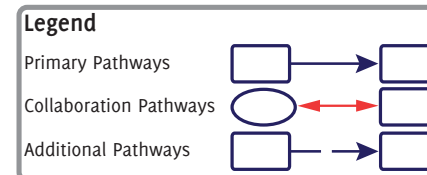
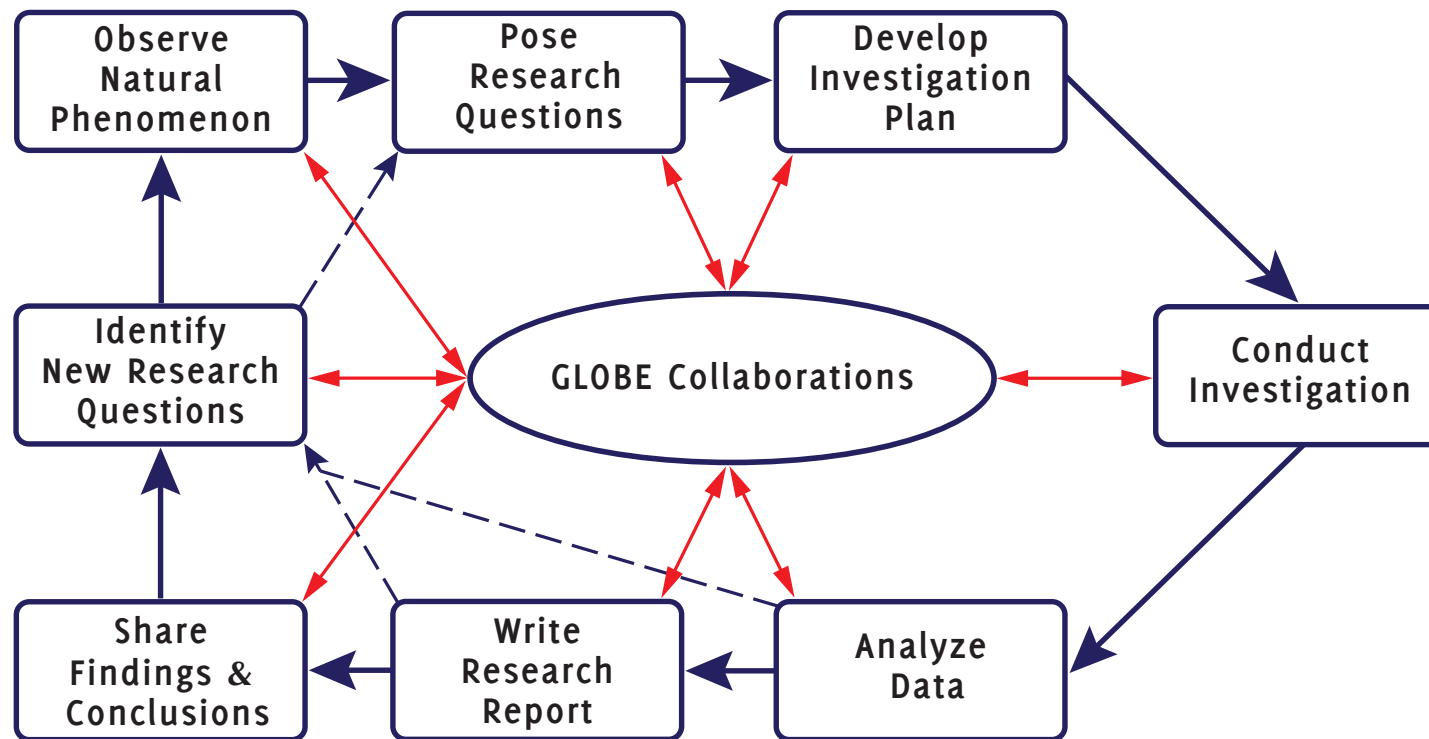


Cape Town, South Africa June 22 - 28, 2008

Investigating Earth as a System

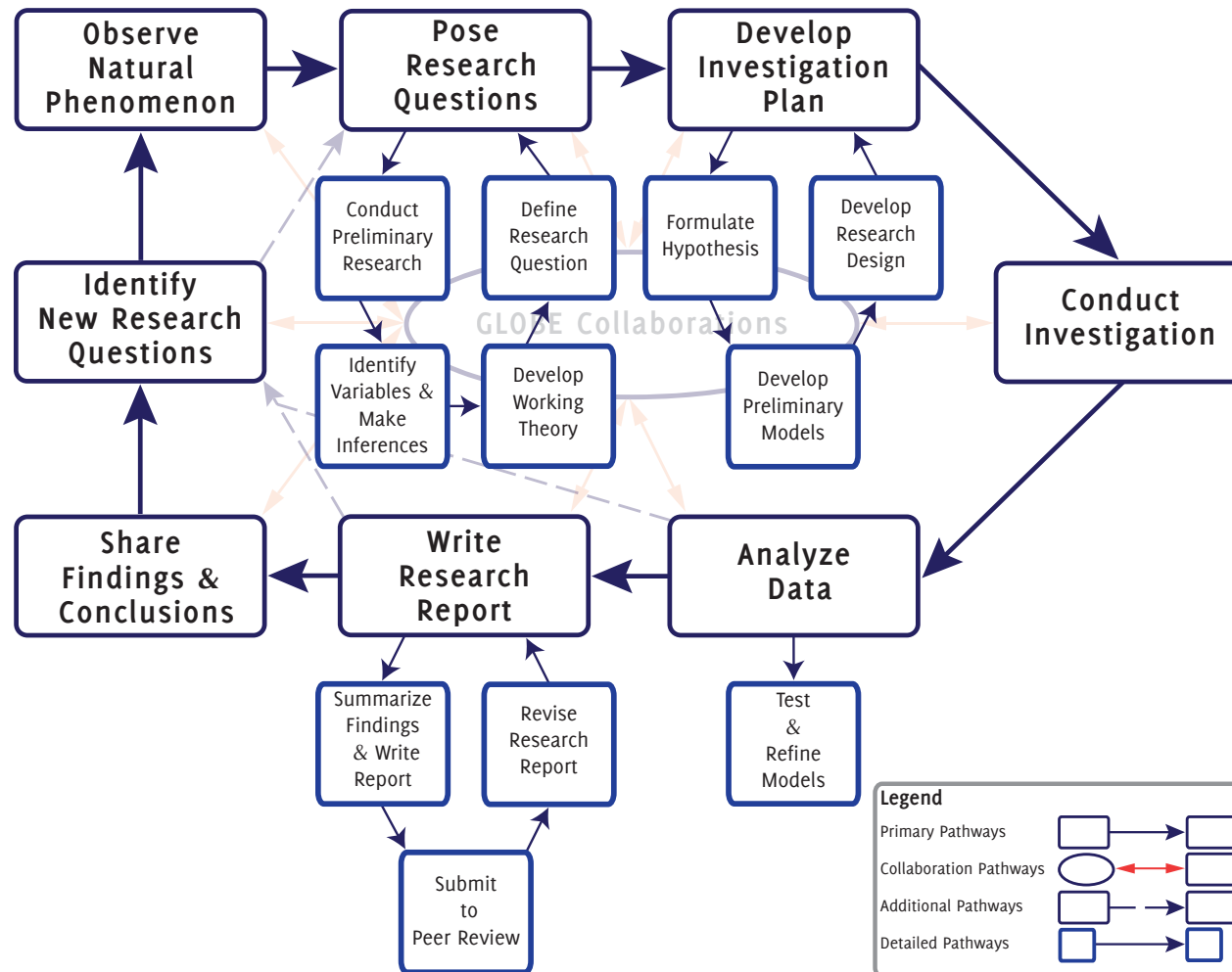


GLOBE Model for Student Scientific Research



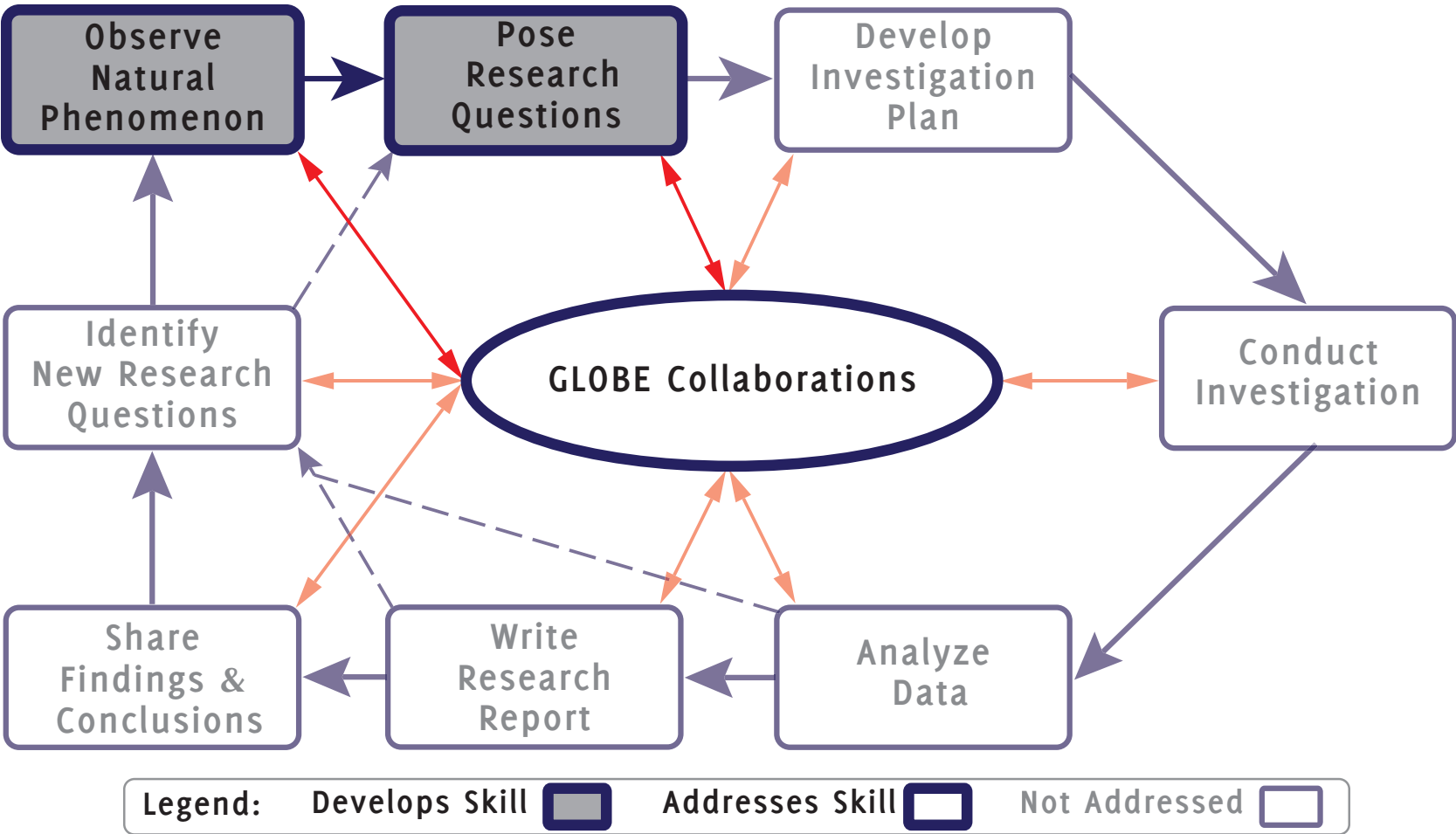


GLOBE Model for Student Scientific Research





GLOBE Model for Student Scientific Research





Guiding Questions

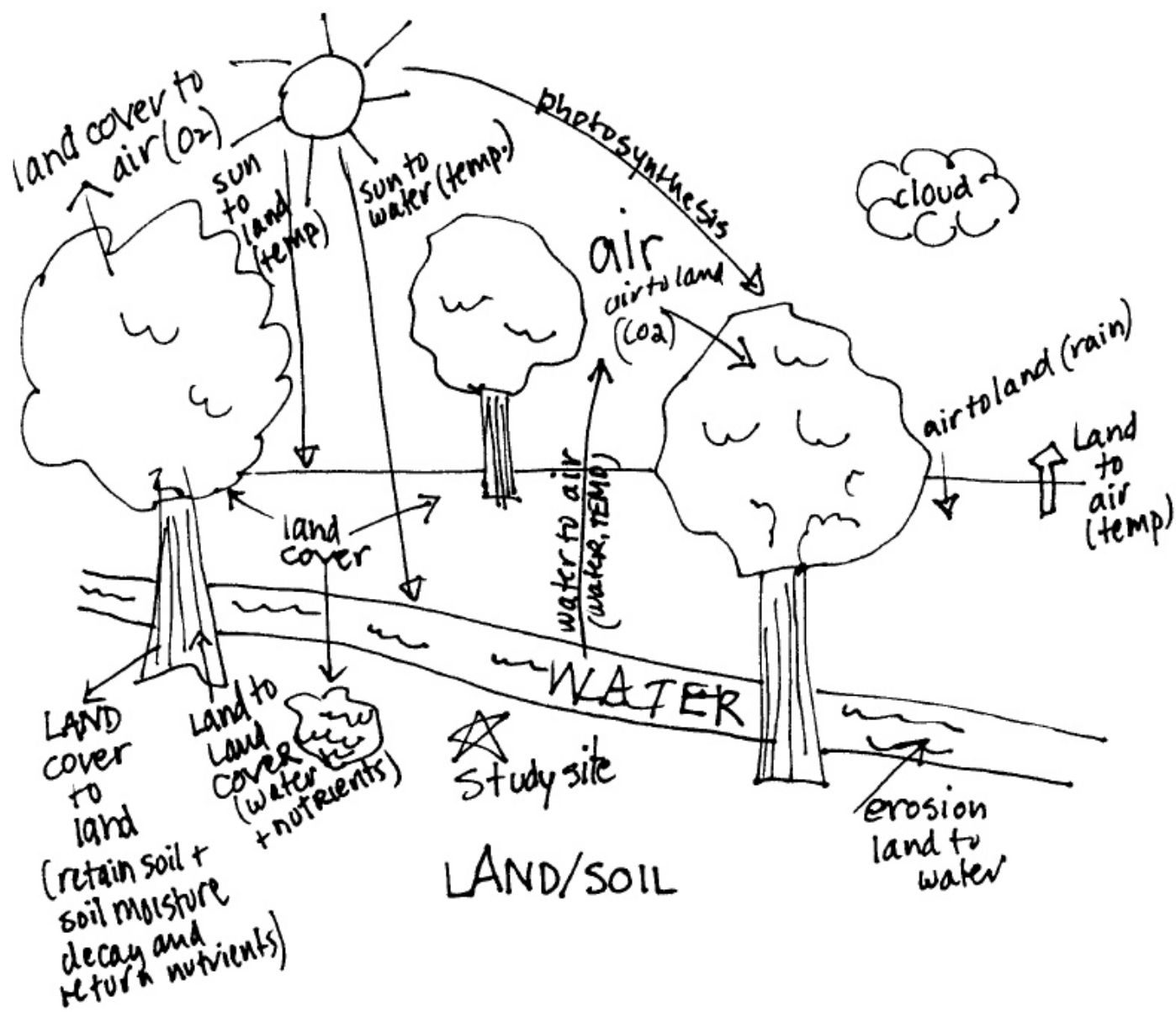


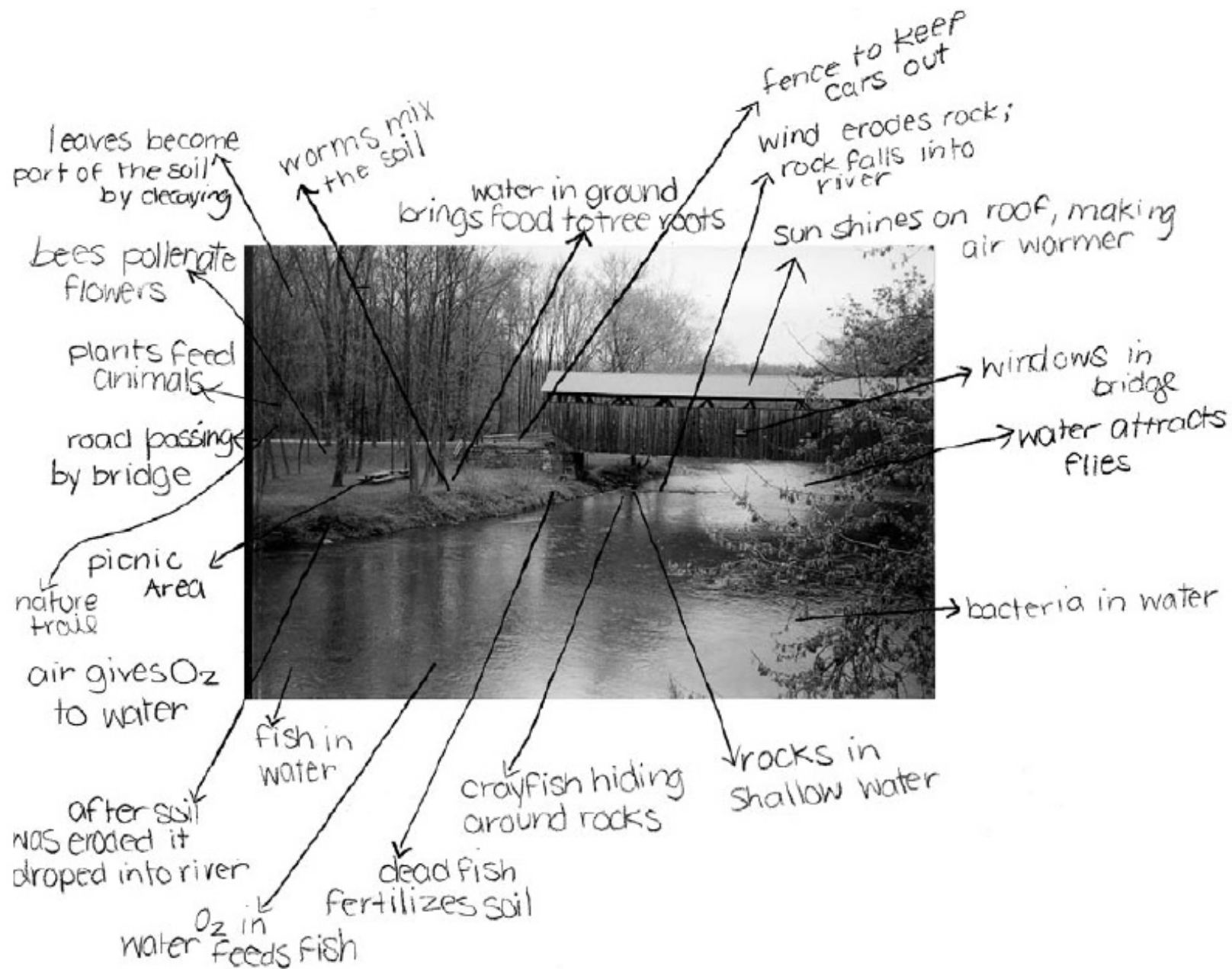
Exploring Earth System Connections



Field Sketching & Annotation









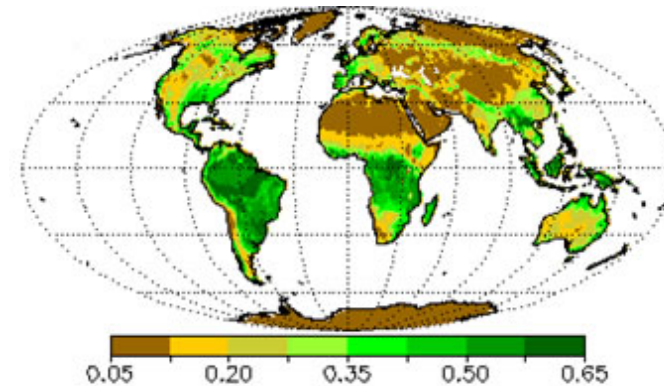
Field Data Collection



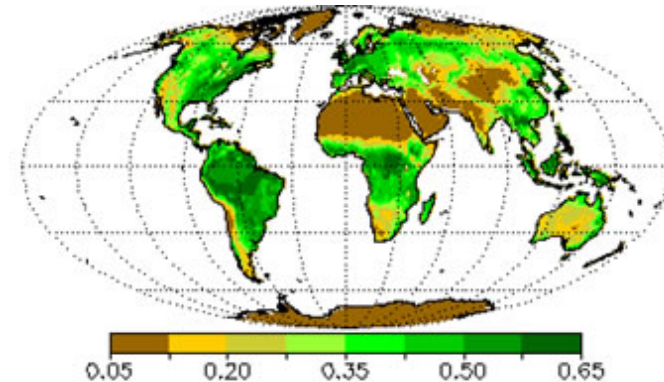
Phenology

Phenology is the study of living organisms' response to seasonal and climatic changes in their environment.

- Variations in day length or duration of sunlight
- Precipitation
- Temperature
- Other life-controlling factors



March
1987



May
1987



Phenology Protocols

- Budburst
- Green-Up
- Green-Down
- Arctic Bird Migration Monitoring
- Ice Seasonality
- Frost Tube
- Mosquito
- Ruby-throated Hummingbird
- Lilac Phenology
- Phenological Gardens
- Seaweed Reproduction





Budburst Observations

- When does budburst occur for the dominant tree species?
- How does budburst differ between different tree and shrub species within a forested study area?
- How does budburst vary year to year for the same species?
- Which environmental factors most affect the timing of budburst on a particular species?



What is Budburst?

Dormancy is a state of suspended growth and metabolism.

Budburst is the emergence of new leaves (photosynthetically active foliage) on plants, which signals the beginning of a new growing season cycle.



Dormant Bud



Budburst



Budburst: Equipment

- GPS Receiver
- Local Tree Identification Guide
- Flagging Tape & Marker
- Binoculars (*optional*)



Budburst: Site Selection

Site Selection

- At least 2 weeks before budburst
- Convenient location
- Native trees that are minimally watered or fertilized are preferred

Tree Selection

- Identify dominant tree species
- Choose measurement strategy
 - Dominant overstory species
 - More than one overstory species
 - Overstory and/or understory species
- Flag at least two trees from each species



Budburst: Data Collection

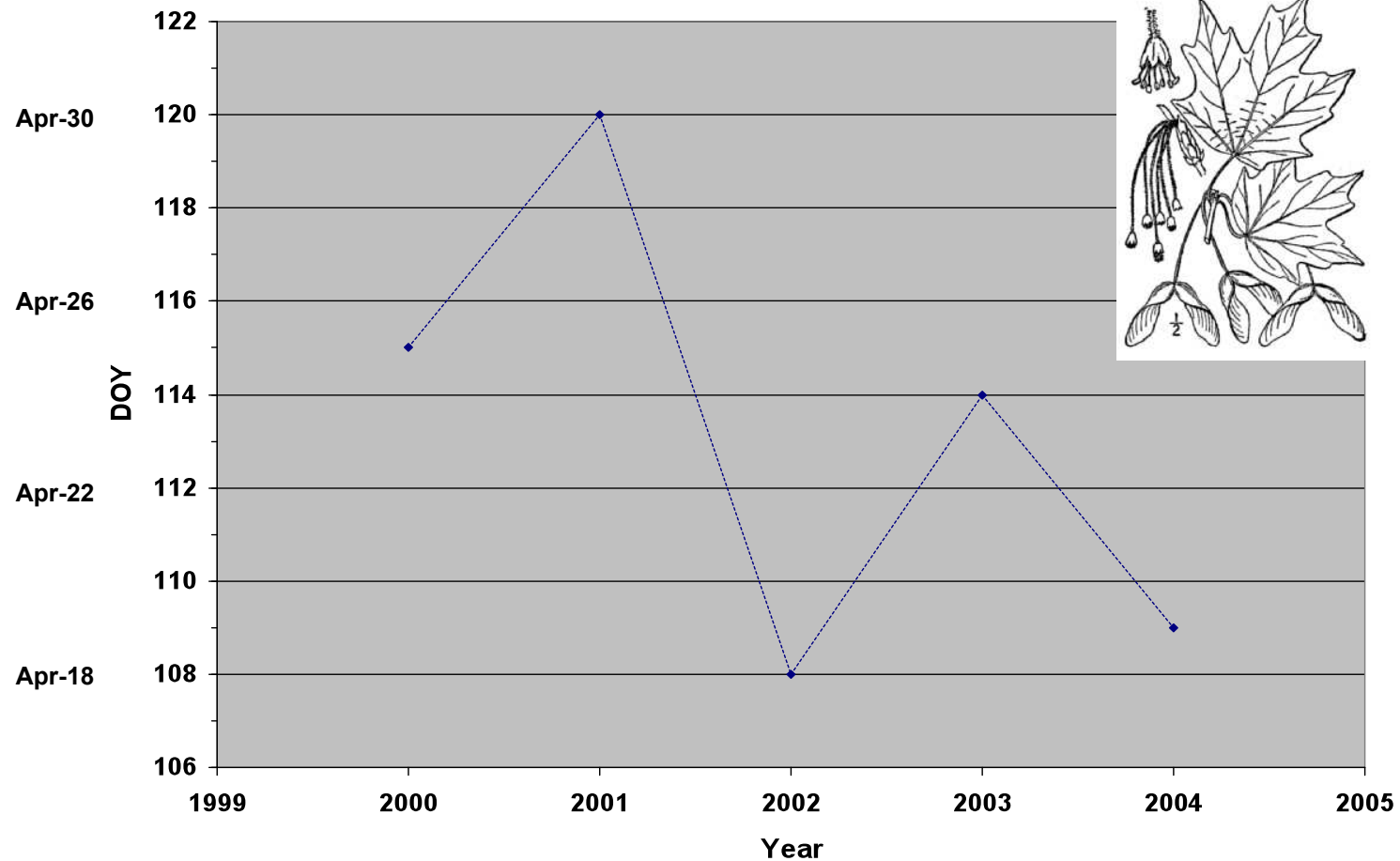
- Observe selected trees at least two weeks prior to budburst
- Visit twice a week, initially until budburst appears anywhere on tree
- Visit daily until budburst is seen on three separate locations of each tree





Looking at the Data

Day of Year (DOY) of *Acer saccharum* Budburst
Five Hawks Elementary School, MN, US





Phenology Research Results

- Calculate growing season length and monitor inter-annual changes in growing season duration.
- Determine how environmental conditions such as air and soil temperature, soil moisture, and day length affect plant growth.
- Monitor the nature and extent of climate change and its effects on plants and animals.
- Help interpret satellite observations of greenness.



Extending the Research

GLOBE



**Partnering students, teachers and scientists
working together to gain a better understanding of
our planet.**

[**www.globe.gov**](http://www.globe.gov)